

7. DUST PALLIATIVE USE

Many of the mitigation practices discussed in the previous chapter included references to the application of dust palliatives or chemical dust suppressants, or discussed chemical stabilization. This chapter reviews the most commonly used palliatives and introduces some recent analysis with respect to their relative effectiveness. The most common approaches appear to be the two extremes: watering and paving. A wide variety of dust suppressants have been tested, but even the manufacturers of the palliatives themselves agree that more research needs to take place with respect to the comparative cost-effectiveness of the different chemicals and their applicability in different weather and soil conditions.

Table 24 shows the source and functional mechanisms of the most common suppressants, and table 25 summarizes their performance and environmental considerations.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION (MCDOT)

The Maricopa County Department of Transportation (MCDOT) conducted tests of eight dust palliative products during the 1996-1999 period:

- Soil-Sement, an Acrylic Co-Polymer
- Polytac, an Acrylic Co-Polymer
- Dustac, Calcium Lignosulfonate
- Timet, Magnesium Chloride
- Pennzsuppress D, a Petroleum Resin
- Coherex, a Petroleum Resin
- Road Oyl, Tall Oil Pitch
- EB001, an Organic Acid

A dust palliative report prepared by MCDOT documents the results of the testing and makes recommendations with respect to product choices and application methods.^[16]

Methodology

The MCDOT staff developed an in-house vacuum powered dust-collecting unit mounted on a pickup truck with a scoop extending below the rear bumper. The set-up is depicted in figure 31. The truck is driven at 35 mph for one-half mile and the dust raised by the moving vehicle is captured by a filter within the dust-collecting unit for subsequent weighing. Three vehicle runs were made and the amount of dust collected each time weighed. The three results were then averaged to obtain an average sample size in grams, which was called the dust rating.

**TABLE 24. SOURCES AND FUNCTIONAL MECHANISMS
OF CHEMICAL DUST SUPPRESSANTS**

Types and Brand Names	Source	Functional Mechanism
Freshwater	From surface or ground water sources (need water right permit)	Moisture wets particles, increasing their mass and binding them together
Calcium Chloride (Generically available as flakes or pellets)	Byproduct of ammonia-soda (solvary) process; also produced from natural salt brine	Deliquescent and hygroscopic; i.e., attracts and retains moisture at a relative humidity equal to or greater than 29% (77 F)
Magnesium Chloride: <i>DustGard</i> <i>Dust-Off</i>	Produced from natural salt brine; by-product of potash production; produced from the reaction of magnesium hydroxide (from sea water or dolomite) with hydrochloric acid	Deliquescent and hygroscopic; i.e., attracts and retains moisture at a relative humidity equal to or greater than 29% (77 F)
Lignin Derivatives: <i>Dustac</i> (<i>Lignosite</i>) <i>Road Binder</i>	Paper-making industry byproduct containing lignin and carbohydrates in solution. Specific composition depends on chemicals and processes used to extract cellulose	Act as adhesives, binding soil particles together
Tree Resin Emulsions: <i>Road Oil</i> <i>Enduraseal 200 (ENTAC)</i> <i>Dustbinder</i> <i>DustControlE (RESTAC)</i> <i>Dustrol EX (J-30EX)</i>	Emulsions produced from pine tree resins	Act as adhesives, binding soil particles together
Synthetic Polymer Emulsions: <i>Soil Sement</i> , <i>Soil Seal</i> <i>Top Seal (Dust-Seal) ECO-CF (Sand Glue)</i> <i>Soil Master WR-RSB</i> <i>Aerospray 70A Marloc</i>	Synthetic formulations composed of polyvinyl acetates, vinyl acrylic copolymer methacryl methacrylates, polybutadiene, et. al.	Bind soil particles together by forming a polymerizing matrix; function similar to adhesives
Bitumens, Tars, and Resins: <i>Residual Fuel Oil Technical</i> <i>White Oils</i> <i>Fuel oils #4, #5, #6</i> <i>Asphotac</i> <i>DL-10, CSS-1, CMS-2S</i> <i>Arcadia oil, PEP</i> <i>Pennzsuppress D</i>	Petroleum, coal, and plastics industry byproducts	Asphalt and resinous products are adhesive, binding soil particles together. Petroleum oil products coat soil particles, increasing their mass and binding them together
Geotextiles: <i>Trevira</i> <i>Spunbond</i> <i>Amoco</i>	Manufactured polypropylene and polyethylene fabrics	Provide and maintain drainage; improve load supporting properties; prevent upward migration of subgrade fines; separate road materials

Source: Paradise Valley Community College, Environmental Health and Safety Technology Program^[17]

**TABLE 25. PERFORMANCE AND ENVIRONMENTAL CONSIDERATIONS
OF DUST SUPPRESSANTS**

Types and Brand Names	Performance Advantages	Performance Limitations	Environmental Considerations
Freshwater	Usually readily available, low material cost, easy to apply.	Frequent light applications may be necessary during hot, dry weather; therefore, potentially labor intensive. Overapplication may result in loss of traction, erosion, or points of road failure.	Minimal environmental hazard. If applied excessively, may result in tracking onto paved roadways, requiring prompt cleanup. Supply may be limited in some areas.
Calcium Chloride (Generically available as flakes or pellets)	Reduces evaporation rate of surface moisture 3.4 times; lowers freezing point of water to -60 degrees F (30% solution) minimizing frost heave and reducing freeze-thaw cycles; increases compacted density of road material; effectiveness retained after reblading.	Effectiveness in arid and semi-arid regions may be limited due to low relative humidity; very corrosive to aluminum alloys; slightly corrosive to steel. Solubility results in leaching during heavy precipitation. Releases heat when mixed in water.	Repeated applications and long-term use may harm adjacent and nearby vegetation. (Contact dust suppressant product vendors for additional product-specific information.)
Magnesium Chloride: <i>DustGard</i> <i>Dust-Off</i>	Reduces evaporation rate of surface moisture 3.1 times, lowers freezing point of water to -27 degree F (22% solution) minimizing frost heave and reducing freeze-thaw cycles; increases compacted density of road material, more so than calcium chloride; effectiveness retained after reblading.	Effectiveness in arid and semi-arid regions may be limited due to low relative humidity; very corrosive to steel, though inhibitions can be added. Solubility results in leaching during heavy precipitation.	Repeated applications and long-term use may harm adjacent and nearby vegetation. (Contact dust suppressant product vendors for additional product-specific information.)
Lignin Derivatives: <i>Dustac</i> (<i>Lignosite</i>) <i>Road Binder</i>	Greatly increases dry strength of soil; not humidity-dependent; imparts some plasticity to road surfaces; lowers freezing point of road surface and base, effectiveness retained after reblading.	High solubility results in leaching during heavy precipitation, corrosive to aluminum alloys due to acidity (CaCO ₃ added ingredient, can neutralize acidity). Proper aggregate mix (4-8% fines) important to performance. Becomes slippery when wet, brittle when dry.	Lignin products have a high BOD (biological oxygen demand) in aquatic systems. Spills or runoff into surface or groundwater may create low dissolved oxygen conditions resulting in fish kills or increases in groundwater concentrations of iron, sulfur compounds, and other pollutants. (Contact dust suppressant product vendors for additional product-specific information.)

**TABLE 25. PERFORMANCE AND ENVIRONMENTAL CONSIDERATIONS
OF DUST SUPPRESSANTS (Continued)**

Types and Brand Names	Performance Advantages	Performance Limitations	Environmental Considerations
Tree Resin Emulsions: <i>Road Oil</i> <i>Enduraseal200 (ENTAC)</i> <i>Dustbinder</i> <i>DustControlE (RESTAC)</i> <i>Dustrol EX (J-30EX)</i>	Low solubility after curing, minimizes leaching and provides degree of surface waterproofing. Imparts some plasticity to road surfaces. High bonding strength; noncorrosive.	Requires proper weather and time to cure. No residual effectiveness after reblading. Equipment requires prompt cleanup to avoid curing of resin in hoses and pipes.	Contact dust suppressant product vendors for additional product-specific information.
Synthetic Polymer Emulsions: <i>Soil Sement,</i> <i>Soil Seal</i> <i>Top Seal (Dust-Seal) ECO-CF (Sand Glue)</i> <i>Soil Master WR-RSB</i> <i>Aerospray 70A</i> <i>Marloc</i>	Applicable to a range of emission sources; functions well in sandy soil conditions. Some types allow seeded vegetation to grow through the polymer matrix.	Requires proper weather conditions and time to cure, may be subject to UV (sunlight) degradation; application equipment requires timely cleaning; no residual effectiveness after reblading.	Contact dust suppressant product vendors for additional product-specific information.
Bitumens, Tars, and Resins: <i>Residual Fuel Oil</i> <i>Technical White Oils</i> <i>Fuel Oils #4, #5, #6</i> <i>Asphotac</i> <i>DL-10, CSS-1, CMS-2S</i> <i>Arcadia oil, PEP</i> <i>Pennzsuppress D</i>	Water insoluble when dry; provides a degree of surface waterproofing. Good residual effectiveness.	Surface crusting, fracturing and potholing may develop with some of these products; long-term application of some of these products may cause road to become too hard for reblading; won't lower freezing point; petroleum oil products lack adhesive characteristics.	Use of used oils is prohibited. Some petroleum-based products may contain carcinogenic polycyclic aromatic hydrocarbons (PAHs). (Contact dust suppressant product vendors for additional product-specific information.)
Geotextiles: <i>Trevira</i> <i>Spunbond</i> <i>Amoco</i>	Flexible, durable, water permeable, and resists soil chemicals; reduces amount of aggregate required during initial construction; lower maintenance costs.	High material cost; material degrades in sunlight, if exposed.	None

Source: Paradise Valley Community College, Environmental Health and Safety Technology Program^[17] and "Techniques for Dust Prevention and Suppression," Washington State Dept. of Ecology Publication Number 96-433^[18]

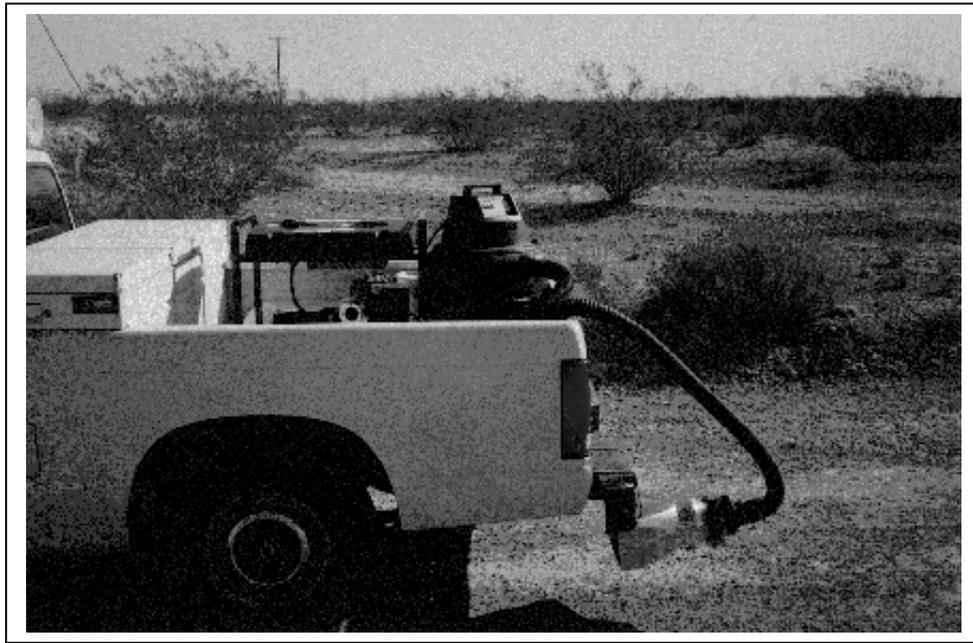


FIGURE 31. MCDOT DUST COLLECTING PROCEDURE

Source: Maricopa County Department of Transportation

The half-mile of roadway to be tested was graded and compacted, and a series of runs was made to obtain a preapplication rating. After the palliative product was applied, runs were made at two months, three months, six months, eight months, and one year after the applications. After a series of runs, the percentage of dust reduction compared with the preapplication test was calculated. The costs of the different products were also tabulated, and are presented in table 26.

URS CORPORATION STUDY

The URS Corporation conducted six-month and 12-month evaluations of fugitive dust control measures for the Arizona Department of Emergency and Military Affairs (ADEMA). The purpose of the project was to evaluate the effectiveness of two dust palliatives, EnviroClean®, a synthetic hydrocarbon emulsion (clear oil) palliative and Soil Sement®, an acrylic polymer type palliative to suppress dust at two locations within the Florence Military Reservation (FMR) in Central Arizona.^[19, 20]

Project Approach

The locations tested were the Mesa Staging Area (MSA) and the Main Supply Route, which both experience heavy traffic with an assortment of vehicle types. After the initial application of the palliatives, evaluations were performed at each site at three intervals:

TABLE 26. DUST PALLIATIVE COSTS

	Product Application Per Mile**						Total Cost	
	Product Cost (\$) (product concentrate)	Total Product (gallons concentrate)	Total Liquid (diluted gallons)	Delivery Charge (30 mile radius)	Application Charge (2 hours on site)	Total Cost Per Mile + Tax (7.05%)	Application Frequency Per Year	Total Cost Year/Per Mile
Soil-Sement™	\$3.12	1151.74	11,517.4	\$0.00	\$0.00	\$3846.77	1	\$3846.77
Dustac®	\$1.18	220	1760	\$0.00	\$0.00	\$277.90	3	\$833.70
Timet™	\$0.32	1760	1760	\$0.00	\$0.00	\$602.91	3	\$1808.73
Soil Master WR™	\$7.25	158.4	2534.4	\$79.20	\$150.00	\$1,474.72	3	\$4,424.16
Coherex®	\$1.30	704	3520	\$127.54	\$170.00	\$1,298.24	3	\$3,894.71
Road Oyl®	\$2.09	1056	6336	\$261.26	\$200.00	\$2,856.42	3	\$8,569.25
Pennzsuppress D®	\$3.60	1196.8	9574.4	\$0.00	\$0.00	\$4,612.23	3	\$13,836.68
Ligno 10™	\$0.43	352	1760	\$54.98	\$150.00	\$381.46	4	\$1,525.85

Source: Maricopa County Department of Transportation, *Dust Palliative Testing*, 1998^[6]

Notes:

- 1) All cost figures are for dust palliatives delivered and applied by vendor.
- 2) Total Miles = All Major and Minor Arterial Roads (Class 3, 4, 8, and 9) within Maricopa County's nonattainment area.
- 3) Product Costs for Soil-Sement, Dustac, and Timet reflect prices on Article 3 Materials Contract effective July 1, 1998.

** The dust palliative was used on 6-foot shoulders, both sides of the road = 7040 sq yards.

within two weeks of the application, approximately six months after the application, and approximately 12 months after the application.

The effectiveness of each of the products, at the time of each evaluation, was assessed with respect to the provisions of Air Pollution Control Regulation 2-8-300 of Pinal County, within which both the FMR and the ADEMA scope of work are located. Both of these provisions limit the opacity of air pollutant emission to 20 percent at the fence line or property line. The ADEMA scope of work also provides that opacity from any site within the property would not exceed 25 percent. The effectiveness of the palliatives in mitigating the migration of dust plumes from the test sites toward the Florence Gardens community located west of the FMR was also assessed.

URS consultant team members performed opacity observations in accordance with the EPA Reference Method 9 as codified in the Code of Federal Regulations (CFR) Volume 40, Part 60, Appendix A. Reference Method 9 provides for the performance of a series of 24 observations every 15 seconds over a 6-minute period. Such a method is also known as the 6-minute rolling average method. However, the traffic on the study areas during the observation periods was too intermittent to facilitate the conduct of 6-minute rolling averages. A 3-minute rolling average was agreed to by all parties prior to the performance of the observations.

Conclusions and Recommendations

Following the six-month evaluation, the following conclusions were made:

- The opacities of the dust plumes generated by the vehicles on both the EnviroKleen® and Soil-Sement® treated areas were all below 20 percent at the property line as required.
- The combined application of coarse rock material and EnviroKleen® at the MSA appear to provide excellent control of fugitive dust.
- Both palliatives appear to tolerate traffic by heavy vehicles of both rubber tired and the tracked types.
- Rubber-tired vehicles eject more fugitive dust than tracked vehicles.

Similar conclusions were drawn following the 12-month observations. In addition, the consultant team concluded that Soil-Sement® was more effective than EnviroKleen® in mitigating dust opacity at wash crossings. Downstream edges of the crossings should be treated with additional Soil-Sement at the expected discharge points to reduce or eliminate erosion. In addition, riprap material could be used to control erosion.

CLARK COUNTY

On February 22, 2001, the Clark County District Board of Health issued a document titled *Section 94 Handbook - Interim Policy On Dust Palliative Use In Clark County, Nevada*. The objective of the interim policy is ensure that air quality fugitive dust controls are implemented in ways that do not adversely impact other aspects of the environment by contaminating the soil or the groundwater.^[21]

Specifically, the policy document is intended to provide guidance on the use of dust palliatives and to prevent the use for dust suppressing purposes of chemical agents that have already been banned for other uses such as pest control. The policy also expressly prohibits the use of any materials containing dioxins, asbestos, or polychlorinated biphenyls in any measurable amount. The interim recommendations are based on existing Nevada statutes that address contamination of soil, groundwater, and surface water, the definition of “hazardous waste” and “used oil,” regulations for combining and disposing used oil and hazardous waste, and compliance with Federal regulations.

The interim policy provides requirements regarding the usage of various palliatives in the vicinity of open bodies of water, wells, natural washes, and flood control channels. Additional topics covered include the dilution of dust palliatives and the cleaning of tanks in which palliatives have been stored, the application of palliatives in traffic and nontraffic areas, and the joint application of palliatives and pesticides.

MARICOPA ASSOCIATION OF GOVERNMENTS

The MAG has published a 2001 update to their “Uniform Standard Specifications for Public Works Construction”. Section 230 of the specifications addresses the application of dust palliatives and includes rules pertaining to equipment to be used, surface preparation, and weather conditions. Section 792 provides specifications of the palliatives including the different types of materials used, typical dilution ratios and application rates, and applicable environmental criteria.^[22]

Both the MAG Uniform Standard Specifications 2001 update and the Clark County interim policy covered in the previous section include dilution ratios and application rates for common dust suppressants. A comparison of the provisions of the two jurisdictions is shown in table 27.

TABLE 27. COMPARISON OF MAG AND CLARK COUNTY DILUTION RATIOS AND APPLICATION RATES FOR DUST SUPPRESSANTS

Product Type	Use/Treatment	Dilution Ratio			Application Rate		
		Maricopa		Clark	Maricopa		Clark
		Range	Typical	Range	Typical	Range	Typical
Acrylic Copolymer	Topical - road or parking lot	20:1 to 4:1	9:1	12:1 to 4:1	9:1	0.20 to 0.10	0.5
	Topical - road shoulder	20:1 to 4:1	15:1	12:1 to 4:1	9:1	0.16 to 0.09	0.5
	Surface course (per inch of depth)	20:1 to 4:1	9:1	12:1 to 4:1	9:1	0.10 to 0.06	0.25 to 0.50
Petroleum Resin Emulsified	Topical - road or parking lot	4:1	4:1	8:1	4:1	0.15 to 0.10	0.50
	Topical - road shoulder	10:1 to 7:1	8:1	10:1	7:1	0.15 to 0.07	0.25
	Surface course (per inch of depth)	4:1	4:1	8:1	4:1	0.11 to 0.07	0.40
Lignin-Based Type (Lignosulfonate)	Topical - road or parking lot	1:1	1:1	1:1	1:1	0.10 to 0.05	0.50 to 1.00
	Topical - road shoulder	7:1 to 4:1	4:1	7:1 to 4:1	4:1	0.05 to 0.03	0.15 to 0.20
	Surface course (per inch of depth)	1:1	1:1	1:1	1:1	0.30 to 0.10	0.25 to 0.50
Organic Resin	Topical - all	10:1 to 2:1	5:1	10:1 to 2:1	5:1	0.25 to 0.15	1.00
	Surface course (per inch of depth)	2:1 to 1:1	1:1	2:1 to 1:1	1:1	0.15 to 0.10	0.15

Source: Maricopa Association of Governments, *Uniform Standard Specifications for Public Works Construction, 2001 Update*, Section 792^[22]
 Clark County District Board of Health, *Section 94 Handbook - Interim Policy On Dust Palliative Use In Clark County, Nevada*, February 2001^[21]